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Sleep EEG: A Novel Approach for Alzheimer's disease Detection

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Background: Early detection of Alzheimer's disease (AD) remains a significant challenge in geriatric medicine. While current diagnostic methods often require extensive neuroimaging or invasive procedures, electroencephalography (EEG) presents an accessible alternative. This study explores the diagnostic potential of overnight EEG recordings using a simplified, single-channel approach.

Methods: We conducted analyses on overnight EEG data collected from the left central channel during polysomnography of 28 older men from the Osteoporotic Fractures in Men Study (MrOS). The study population comprised 14 participants with clinically diagnosed AD and 14 matched controls. Sleep stages (wake, N1, N2, N3, REM) were classified in 30-second epochs. We computed fuzzy entropy across multiple frequency bands (Delta: 0.5-4 Hz, Theta: 4-8 Hz, Alpha: 8-13 Hz, Beta: 13-30 Hz, Low Gamma: 30-60 Hz, Full Range: 0.5-60 Hz). Classification was performed using a support vector machine with leave-one-out cross-validation.

Results: Analysis of 30 entropy features (5 sleep stages and 6 frequency bands) revealed effect sizes (Cohen's d) ranging from 0.026 to 0.761, with the strongest discrimination observed in the Theta band during REM sleep. Optimal classification performance achieved an AUC-ROC of 0.990 using a 10-feature model.

Conclusion: This study demonstrates the viability of single-channel EEG monitoring during sleep as a potential screening tool for AD. The strong classification performance suggests this simplified approach could provide an accessible method for identifying individuals at risk of AD, particularly in settings where comprehensive neurological assessments are not readily available

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